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A STUDY TO DETERMINE

IF A DIFFERENCE EXISTS AMONG THE CUMULATIVE INCIDENCE OF ACUTE RESPIRATORY DISEASE HOSPITAL ADMISSIONS OF THREE GROUPS OF ARMY BASIC TRAINEES AS DEFINED BY THE DESIGN OF BARRACKS IN WHICH THEY ARE HOUSED

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Using chi-square tests of homogeneity, a selected sample of Army Basic Trainees at Ft. Jackson was studied to determine if there was a difference in cumulative incidence of acute respiratory disease (ARD) hospital admissions in three types of barracks - WWII, rolling pin, and starship. Period of training for sample soldiers was January to May 1985. Results of testing for the female trainees indicated no significant difference in incidence of ARD among three barracks groups. Results of testing for male trainees indicated statistically significant differences of ARD among each of three barracks groups. A consistent pattern of ARD incidence rates by barracks type emerged for both males and females. Barracks group ARD incidence rates rank ordered from highest to lowest for both genders, were first WWII, then starship, and finally rolling pin.

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L.I.D.

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I. INTRODUCTION

Background Information

It has been estimated that upper respiratory tract infections account for over 50 percent of all time lost from the work place because of acute illnesses[1] and for about 50 percent of all visits to the family physician.[2] There has been, over the years, much interest in the occurrence of upper respiratory tract infections among special groups such as college students and military recruits because of their unique environmental settings and their housing accommodations and, for the military recruits in particular, because of the striking changes in lifestyle during initial transition from the civilian to the military community.

Acute respiratory disease (ARD) is "an ill-defined group of upper respiratory tract infections which cannot be classified as one of the other respiratory syndromes because the nose does not run enough, the throat is not sore or red enough, and the cough is not severe or paroxysmal enough."[3] Fever, malaise, and generalized aching are almost always symptoms. The etiology of ARD varies among population groups, with patterns for military recruits being very different from those of college students and the civilian community in general.[4] Acute respiratory disease caused by adenoviruses has been found to be "the most significant cause of morbidity in military populations recently removed from civilian life.... The disease is of variable clinical severity, but results in hospitalization of approximately half of those

infected."[5] Because of these findings, since 1971, Army recruits arriving at their initial entry training installations during the period October 1 through March 31 received an adenovirus vaccine, and hospital admission rates for ARD patients were significantly reduced almost immediately by 25 percent. Each year during the adenovirus vaccine administration period, admission rates would drop and remain low. From calendar year 1976 to 1983, annual ARD admission rates for trainees consistently dropped from 340 cases per 1000 to 175 cases per 1000. In 1983, the Army established a policy of year-round adenovirus vaccination for all initial entry trainees. In spite of the significant gains made in reducing ARD hospital admissions of trainees, however, a significant problem still exists.[6]

Conditions Which Prompted the Study

In response to increasing meningitis rates among basic trainees at Fort Benning, Georgia, in the early 1980s, a study was conducted in late 1983. It was noted that the disease had been primarily confined to only one of the two training brigades, the one occupying a new barracks complex, commonly referred to as a "starship" barracks. During the study, it was noted that this same brigade had significantly higher ARD rates than the other brigade, which occupied older, World War II-style barracks. A ventilation insufficiency in the "starship" barracks was thought at the time to have been a contributing factor.[7]

Interest in the issue of barracks design and patterns of illness continued to grow. The Fort Benning study had prompted questions within the Office of The Surgeon General, at the basic training installations, and at various levels between. The Fort Jackson, South Carolina, command group was acutely interested in the impact of ARD admissions on training, and hospital staff had been providing installation staff selected data on ARD admissions over a period of years. To this author's knowledge, no statistically sound study had yet been done to examine the relationships between barracks types and ARD illness patterns at Fort Jackson.

During the period of this study, recruits at Fort Jackson were being housed in three types of barracks: (1) World War II-vintage wooden barracks, (2) early 1960s-vintage "rolling pin" barracks, and (3) 1970s- and 1980s-vintage "starship" barracks complexes. The command wanted to know if there was a difference in ARD hospital admission rates among the trainee population in the three types of barracks.

Fort Jackson and the Initial Entry Training Environment

Fort Jackson, located near Columbia, South Carolina, is the Army's most active initial entry training center, providing a training environment for approximately 25 percent of the enlisted personnel entering the U.S. Army annually.[a] The primary mission of the U.S. Army Training Center and Fort Jackson is to train the enlisted initial entry soldiers in basic training (BT) and, for selected military occupational specialties, advanced individual

training (AIT). Through basic training courses of instruction at Fort Jackson pass approximately 40,000 soldiers each year, with nearly half of the BT graduates remaining to attend one of the AIT courses in such combat support skills as personnel records, personnel actions, administration, food service, unit supply, and mechanics for various types of military equipment.[9]

In order to accomplish the intial entry training mission, the installation's organizational structure includes a reception station and three training brigades. These four commands are the U.S. Army Reception Station (RECSTA), the 1st Basic Training (BT) Brigade, the 2d Basic Training (BT) Brigade, and the 4th Combat Support Training (CST) Brigade. During the training time at Fort Jackson, a soldier is assigned to one of these control units.

Each soldier's initial entry training experience begins at the Reception Station, the largest facility of its kind in the Army. Through this modern complex pass hundreds of enlistees each day. While in the RECSTA, normally for about three days, enlistees process through the physical examination section for immunizations and completion of physical examination if needed, receive uniforms, and initiate permanent Army personnel, medical, and dental records. Concurrent with the accomplishment of these administrative actions, the drill sergeants begin to teach basic military skills.[10]

The number of new enlistees arriving on the installation fluctuates monthly and depends upon a myriad of variables, to

include recruiting efforts, dates of school terms, timing of the Army's needs for particular job specialties, training schedules and capacities, and enlistee personal desires. Historically, the arrivals spike during summer months because of recent high school graduations and increased training demands for Army Reserve and National Guard personnel who are between school terms.[11]

Soldiers depart the RECSTA for a basic training company of the 1st or 2d BT Brigade, where physical and soldiering skills are developed during the rigorous and physically demanding eight-week program. The basic training course is conducted in phases, and trainees must demonstrate at each milestone that they meet specific performance-oriented standards.

Advanced individual training is conducted by the 4th CST Brigade. Training companies of this brigade provide training to qualify soldiers in one of seven military job specialties. The various courses of instruction vary in length from four to eleven weeks.[12]

The U.S. Army Medical Department Activity (MEDDAC), Fort Jackson, provides medical support to training activities on the installation. Moncrief Army Community Hospital, the largest organizational element of the MEDDAC, is housed in a twelve-story facility with approximately 200 inpatient beds and a large modern outpatient clinic. The hospital operates troop medical clinics in support of the training brigades and a physical examination facility in the RECSTA.

Statement of the Research Problem

The research problem was to determine if a difference exists among cumulative incidence of acute respiratory disease (ARD) hospital admissions of three groups of Fort Jackson basic trainees as defined by the design of the barracks structure in which they are housed.

Objectives of the Research

The objectives which had to be achieved to accomplish the research were to:

1. Review previous studies of and literature on the occurrence of ARD among military personnel and among civilian groups similarly housed.
2. Define an "ARD admission" in terms of classification codes used by the staff of the Fort Jackson MEDDAC.
3. Obtain and review data for basic training course inputs and graduates and for hospital ARD admissions for fiscal years 1982-1984 for Fort Jackson, South Carolina, to examine the historical magnitude of ARD incidence among trainees there.
4. Become familiar with the three designs of barracks in which trainees at Fort Jackson are housed.
5. Select from trainees entering the eight-week basic training course three samples of soldiers corresponding to the three types of barracks which the trainees occupy.
6. Follow each group of trainees on a prospective, concurrent basis through the eight-week period, obtaining the barracks

occupancy, attrition, and ARD admission data applicable to each sample.

7. Calculate and compare cumulative incidence of ARD admissions among the samples.

8. Draw conclusions regarding homogeneity of the three trainee barracks groups with respect to the cumulative incidence of ARD hospital admissions.

Criterion

A level of significance of α = .05 was used to determine if a difference exists in cumulative incidence of ARD admissions among the three trainee groups.

Assumptions

For the purposes of this research, it was assumed that:

1. The three trainee groups under study were reasonably homogeneous with respect to their basic demographic characteristics other than gender. Because of the random arrival of incoming trainee personnel to Fort Jackson and the "fill and train" policies in effect, distribution of demographic characteristics other than gender were expected to be similar among the training companies and, therefore, among barracks types.

2. Soldiers in classes, or cycles, of the basic training course received instruction under a standard curriculum, to include all academic, military, physical, technical, and tactical aspects.

3. Cadre of all training units were equally knowledgeable of and complied with training policies and rules governing treatment of trainees promulgated by U.S. Army Training and Doctrine Command and by Fort Jackson.
4. Individual buildings within a barracks design category did not differ appreciably with respect to construction, maintenance status, and internal environmental factors affecting the living conditions of basic trainees housed therein.
5. Preventive medicine measures taken by Fort Jackson training cadre and health services personnel did not differ with the barracks design.

Limitations

The following constraints in this research effort were recognized:

1. Only those ARD cases which were serious enough to result in inpatient treatment in a medical facility were included in this study. It was recognized that a number of trainees with less serious symptoms of ARD were treated on an outpatient basis; however, outpatient data by diagnosis were not being collected by the Fort Jackson MEDDAC.
2. Only those admissions with a primary diagnosis of ARD were considered. Those inpatients with a secondary diagnosis of ARD, i.e., those who were admitted for other diagnoses but who also exhibited ARD symptoms, were excluded.

3. Only basic trainees arriving at Fort Jackson, South Carolina, during the period January through March, 1985, were included in the study.

Review of the Literature

Literature is full of accounts of studies of respiratory infection in various groups, civilian and military. Studies of the occurrence of acute respiratory disease among recruits of all the Armed Forces——Air Force, Army, Navy, and Marine Corps——have been conducted. Investigations have concentrated on a myriad of topics, from identification of etiological agents to distribution of disease by some characteristic of interest to effectiveness of vaccines. Some amount of frustration develops as one attempts to understand the various disease agents, environmental factors, and host characteristics impacting incidence of respiratory disease. Schonell writes:

> The terminology of acute respiratory infections is confusing because of conflicting names given to different syndromes. An anatomical classification is unsatisfactory because many infections are not confined to a single site in the respiratory tract. An etiological classification is impractical because over 100 different viruses and numerous types of bacteria cause respiratory infections and in many cases it is difficult to determine the etiological agent. In addition most organisms do not give rise to illnesses with distinctive clinical features.[13]

To preface one of his articles on clinical syndromes of respiratory disease, Evans presented some basic concepts which he called "The Five Realities," to help clinical investigators deal with their frustrations; these are shown below in Table 1 and serve as a good point from which to begin a review of the literature.

TABLE 1

THE FIVE REALITIES

1. *The same clinical syndrome* may be produced by a variety of agents.
2. *The same etiological agent* may produce a variety of clinical syndromes.
3. *The predominating agent* in a given clinical syndrome may vary according to the age group involved, the year, the geographic location, and the type population (military or civilian).
4. *Diagnosis of the etiological agent* is frequently impossible on the basis of the clinical findings alone.
5. *The cause(s)* of a large percentage of common infectious disease syndromes are still unknown.

SOURCE: Alfred S. Evans, "Clinical Syndromes in Adults Caused by Respiratory Infection," Medical Clinics of North America 51 (May 1967): 804.

Army medical personnel have been aware, from early days of the Army Medical Department, that the unique environmental conditions of military communities, particularly with respect to the crowding and close contact of soldiers in a barracks setting, present challenges in the control of disease transmission. In a 1940 manual of military preventive medicine, Dunham writes that respiratory infections are the most important of the communicable diseases occurring in military forces because of their ease of transmission and potential for reaching epidemic proportions. He notes the particularly high susceptibility of new recruits and describes military unit environments then which sound amazingly similar to those found at initial entry training centers now. He

advises control measures which are still used today in training units——space separation of beds in bays and squad rooms, cubicle screens between beds, and head-to-foot sleeping.[14]

The term "acute respiratory disease" used by the military today saw first use during World War II, originally called "acute respiratory disease of recruits." Reviews of studies by numerous authors——Buescher,[15] Evans,[16] Fraser,[17] Grayston,[18] Rosenbaum,[19] Meiklejohn,[20] and Van Der Veen,[21] to name a few——indicate very different patterns of acute respiratory infections in military recruits than in other similar groups of the same age range, such as college and university students. In each study, it was recognized that adenoviruses played a much larger role in new military recruit ARD than in that of other populations.

Meiklejohn conducted surveillance of febrile upper respiratory diseases in the Air Force recruit population at Lowery Air Force Base, Denver, Colorado, during the 30-year period 1952 to 1982. The objectives of this clinical investigation changed with time. Initially, the study was focused upon discovery of disease agents, primarily viral infuenza strains, and impacts on ARD in vaccinated and unvaccinated recruits. During the second decade of study, research efforts were concentrated on influenza vaccine improvements and development of adenovirus vaccines. Although in the early 1960s recuit housing accommodations at Lowery Air Force Base were upgraded from the World War II-style barracks to modern multistory barracks buildings of unspecified design, the scope of

Meiklejohn's study did not include a look at incidence rates of acute upper respiratory disease as a function of barracks type. He reported no data on ARD incidence by trainee gender.[22]

Buescher et al. studied acute respiratory disease in Army recruits entering basic training at Fort Dix, New Jersey, during January through March, 1965. Their initial study sought to identify etiologic agents. Studies continued in late 1965 and early 1966, focused upon assessing effects of the mass immunization of recruits with adenovirus vaccines. There was no reporting of ARD incidence by trainee gender, nor was there any mention of trainee barracks environment.[23]

Van Der Veen and Van Nunen reported an 18-month study of military basic trainees in a training center at Ossendrecht, The Netherlands, from June, 1961, to December, 1962. The objective of the study was to identify, through acute-phase blood tests and throat cultures the various etilogic agents at work in the male trainee population causing ARD. They tested specifically for ARD cases caused by Mycoplasma pneumoniae and found that about nine percent of the cases not caused by adenovirus or influenza virus were attributable to M. pneumoniae. The only mention of barracks accommodations for the all-male trainee groups was that they were housed in separate company-sized dormitary areas.[24]

A series of articles appeared in the <u>American Journal of Public Health</u> in January, 1965, providing a wide range of information from a ten-year study (1953 to 1963) of epidemiology and

prevention of ARD in trainees at the Great Lakes Naval Training Center. Though focused on isolation of microbial agents from ARD patients, Rosenbaum et al. recognized housing of Navy trainees in the large, open-bay barracks as an epidemiologic factor and noted that crowded living environment, along with other factors, "may accentuate susceptibility to infection."[25] Arlander et al., in a study of Navy and Marine Corps trainees at adjacent California training bases during the winter of 1963, noted marked differences in ARD illness extent and timing patterns by week of training and concluded that ARD rates "closely relate to the methods of handling men and the ... environment into which they are placed." One area of difference between the two service groups was their barracks arrangement. While Navy trainees lived in 74-man open-bay barracks, the 62-man Marine trainee platoons were housed in huts of 20 to 21 men each. Navy trainees had significantly more ARD admissions than their Marine counterparts initially. Then, during the fourth week of training when Marines left their huts to be billeted as larger groups under more crowded and primitive conditions, ARD admission rates increased. Arlander likened the noted differences to those experienced in British military training. The British Air Force groups trainees in large cohorts and has significant trainee adenovirus problems; the British Army and Navy, on the other hand, train new recruits in smaller groups and have minimal trainee respiratory illness.[26]

Kiehl retrospectively studied incidence of ARD hospital admissions of basic trainees in three types of barracks at Fort Knox, Kentucky, during 1983. Trainee gender was not a factor in his study, since all basic trainees at Fort Knox were male. The three barracks types were identified as renovated World War II, cinder block, and Disney; design descriptions of the cinder and Disney barracks were insufficient to compare Knox structures to barracks at Fort Jackson. Likewise, lack of definition of ARD in terms of ICD-9 codes further clouded comparisons of the Knox and Jackson studies. Kiehl compared mean annual ARD incidence rates for paired barracks types and found no statistically significant difference among the barracks types.[27]

Because trainee population at Fort Jackson comprised both males and females, a limited amount of literature dealing with sex-differentiated morbidity was reviewed. Hoiberg——noting U.S. national statistics that women report more illnesses, more hospitalizations, and more illness-related inactive days than do men ——examined hospitalization rates of Navy enlisted women during a ten-year period 1966 to 1975. Each year 25 to 30 percent of Navy enlisted women were hospitalized; by comparison, 11 to 13 percent of Navy enlisted men were admitted annually. From 1966 to 1969, hospitalization of females for respiratory disorders ranked the highest of the 18 major diagnostic categories used in her study:

from 1970 to 1975, admissions for respiratory disorders ranked third, exceeded only by complications of pregnancy/childbirth and mental disorders.[28]

Incidence rates of hospital admissions of recruits at all Army initial entry training centers, to include Fort Jackson, for acute respiratory infections are shown in Table 2 for the period coinciding with that of this study. Rates by gender are shown. Higher female admission rates were noted for each month examined.

TABLE 2

ARD ADMISSION RATES FOR RECRUITS, BY GENDER, AT ALL ARMY INITIAL ENTRY TRAINING CENTERS (Rates are per 1,000 average strength)

Month in 1985	ARD Admissions			Ratio of female to male
	Both sexes	Female	Male	
January	118.7	148.0	113.6	1.3 to 1
February	149.1	229.0	139.1	1.6 to 1
March	89.5	160.9	82.4	1.9 to 1
April	89.6	140.3	82.9	1.7 to 1
May	66.8	117.7	64.0	1.8 to 1

SOURCE: U.S., Department of the Army, Office of the Surgeon General, Patient Administration Division, Health of the Army (Fort Sam Houston, Texas: Patient Administration Systems and Biostatistics Activity, January through May, 1985), p.51.

Nathanson considered, from a theoretical perspective, the apparent contradiction between the favorable mortality rates and unfavorable morbidity rates of females in our society compared to those of males. Just as Hoiberg, she noted more illness, higher

rates of health services utilization, and more days of disability from acute conditions for females than for males. Three models were offered to account for sex-differentiated experiences:

> (1) Women *report* more illness experience than men because it is culturally more acceptable for them to be ill——'the ethic of health is masculine'; (2) the sick role is relatively compatible with women's other role responsibilities, and incompatible with those of men; and (3) women's asigned social roles are more stressful than those of men; consequently, they *have* more illness.[38]

Research Methodology

Collection and recording of data

The collection and recording of data was pursued in the following manner:

1. A search of the literature, both published and unpublished, regarding incidence of ARD in military and civilian settings was conducted. Studies found were reviewed for information pertinent to this research effort.
2. An 'ARD admission' was defined for the purposes of this study in terms of International Classification of Diseases, Ninth Revision (ICD-9) codes used by the staff of the Fort Jackson MEDDAC.
3. The basic training course workload data (inputs and graduates by fiscal year) for Fort Jackson were obtained from the Army Training Requirements and Resources System (ATRRS) automated database for the three most recent fiscal years (1982-1984). ARD admission and discharge data for Moncrief Army Community Hospital, Fort Jackson, for the same three-year period were

obtained from the U.S. Army Patient Administration Systems and Biostatistics Activity. Both sets of data were reviewed in order to examine, in gross terms, the trainee population at risk and ARD admissions trends and, in general, to gain an understanding of the historical magnitude of ARD admissions among basic trainees locally.

4. Visits with training unit cadre, tours of barracks complexes of each of the three designs, and discussions with staff of the installation Directorate of Engineering and Housing were conducted to gain familiarity with the three designs used to house trainees and the current conditions of the facilities. In Appendix A is a listing of the basic training battalions and the types of barracks occupied by the assigned trainees. Additionally, a tour of the reception station and discussions with RECSTA staff provided some exposure to how the recruits arrive, the inprocessing procedures, and the manner in which basic training companies are filled.

5. A projected schedule of basic training classes was obtained from the office of the Directorate of Plans, Training, and Mobilization (DPTM). In conjunction with the DPTM staff, a selection was made of a sample which included trainees housed in each of the three types of barracks. The sample included 46 eight-week training cycles which began during the period January through March, 1985. (Orignially, the study was to include soldiers beginning basic training during the period

November, 1984, through January, 1985, but was altered to start with January, 1985. This change allowed avoidance of the period when a three-week cessation of training occurred for the Christmas/New Year's Day holidays, during which many trainees left the installation to visit family and friends. Potential exposure to etiological agents outside the basic training environment would needlessly add unknown variables to the study.) During the study, DPTM staff provided weekly reports of the status of basic training units. In Appendix B is an example of a weekly status report.

6. The hospital's Patient Administration Division staff provided data on all individual inpatient admissions during the period January through May, 1985. (The 46th BT cycle in the sample, began its training in March and graduated in late May, hence the period of patient admissions review.) An automated database was developed to capture personal and clinical data on every basic trainee admitted during this five-month period. Those trainees assigned to units within the 46-cycle sample were identified.

<u>Evaluation of data</u>

Evaluation of data included the following actions:

1. Collected data were analyzed using the chi-square (X^2) test of homogeneity. Null (H_0) and alternative (H_A) hypotheses which were tested are shown below:

H_o: The three sampled trainee groups are homogeneous with respect to the proportion of trainees admitted to the hospital with an ARD primary diagnosis.
H_A: The three sampled trainee groups are not homogeneous with respect to proportion of ARD admissions.

2. The males and females in each type of barracks were analyzed separately for two reasons. First, their upon arrival in the reception station, males receive an oral bivalent adenovirus vaccine, while females do not. Second, the "fill and train" policies for the two genders differ slightly. Training companies are designated for and filled with females to control the proportion of females assigned to a training battalion. No more than two of five companies in a battalion have female trainees assigned. Also, because of ratios of male to female trainees arriving at Fort Jackson, usually a female training company has a lesser assigned strength than its male counterpart and, therefore, less crowded barracks conditions.

3. In the chi-square test, identical 2 x 3 contingency tables, as shown in Figure 1, were used——one for the female sample and another for the male sample.

Barracks Type

	W	R	S
ARD Admission			
No ARD Admission			
	PAR_W	PAR_R	PAR_S

PAR = population at risk

Barracks type code:
W = World War II
R = Rolling Pin
S = Starship

Fig. 1. Sample Chi-square Contingency Table

The observed number of "ARD admissions" denotes the number of new admissions; repeat admissions of a same patient were not included. The column totals, the population at risk, were controlled and were calculated as follows:

$$PAR = \frac{Si + S1 + S2 + S3 + S4 + S5 + S6 + S7 + S8 + Sg}{10}$$

(where S is trainee assigned strength, and the subsequent character i, 1, 2,...8, or g denotes a point in time, i.e., initial, beginning of training week 1, 2,...8, or graduation respectively.)

The formula takes into account attrition which occurs during a basic training cycle, reducing trainee population at risk. Rather than assuming that attrition occurs uniformly throughout a cycle and using the mean of the initial and graduation strengths, weekly population strengths were considered in the calculation. The observed number of "No ARD admissions" is simply the difference between the PAR and the number of "ARD admissions." Cumulative incidence, or incidence probability (IP), for each sample, the value which the test compares, is represented by the following:

$$IP = \frac{\text{New ARD admissions}}{PAR}$$

4. The calculated X^2 value was compared to the critical X^2 value at the selected level of significance (see criterion) and the null hypothesis rejected or not rejected, as indicated.
5. In any instance where the null hypothesis was rejected, i.e., if there was a statistically significant difference between the proportion of ARD admissions from the different trainee

barracks groups, series of 2 x 2 contingency tables were then used to compare all possible paired combinations of barracks types to ascertain differences between each pair.

Footnotes

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[22]Meiklejohn, pp. 775-81.

[23]Buescher, pp. 769-78.

[24]J. Van Der Veen and M. C. J. Van Nunen, "Role of Mycoplasma Pneumoniae in Acute Respiratory Disease in a Military Population," The American Journal of Hygiene 78 (November 1963): 293-94, 297-300.

[25]Rosenbaum et al., p. 39.

[26]T. R. Arlander et al., "Epidemiology and Prevention of Acute Respiratory Disease in Naval Recruits. IV. An Epidemiologic Study of Respiratory Illness Patterns in Navy and Marine Corps Recruits," American Journal of Public Health 55 (January 1965): 69-79.

[27]Paul V. Kiehl, "Incidence of Acute Respiratory Disease (ARD) in Basic Trainees Relative to Billeting" (Quarterly Management Analysis Project, Baylor University, January 1984), pp. 1, 2, A-1.

[28]Anne Hoiberg, "Health Care Needs of Women in the Navy," Military Medicine 144 (February 1979): 103, 104, 106, 109.

[29]Constance A. Nathanson, "Illness and the Feminine Role: A Theoretical Review," Social Science and Medicine 9 (February 1975): 57, 59.

II. DISCUSSION

Definition of ARD Diagnosis

In the military medical environment, as in its civilian counterpart, a definition of acute respiratory disease diagnosis is amorphous. Those managing the Army acute respiratory disease surveillance program have experienced reporting inconsistencies because of lack of definition standardization. The Army Surgeon General recommended the following for training installations:

> ... ARD should be clearly defined and incorporated into the local installation SOPs [standing operating procedures]. A recommended definition of acute respiratory disease is an acute febrile illness (temp equal to or greater than 100° F) characterized by one or more of the following signs or symptoms: cough, runny nose, sore throat and pleuritic chest pain. Other features such as headache, chills, myalgias, malaise and rash may be noted but by themselves do not establish a clinical diagnosis of acute respiratory disease. Additionally, specific hospital ... admission criteria for ARD should be determined.[1]

Unfortunately, accompanying this recommendation was no ARD diagnosis definition in terms of codes from International Classification of Diseases, Ninth Revision (ICD-9), used by Army medical treatment facilities worldwide to codify patient diagnoses.

The Fort Jackson hospital had no ARD definition in local procedures documentation. Classification of a patient as an ARD was left to the discretion of a discharging physician or, quite often, in the absence of clear guidance in an inpatient treatment record, to a transcription/coding technician in Patient Administration Division. With their training and years of experience, the medical records technicians were more adept at codification

of diagnoses than were attending physicians, and quite reasonably so. On the basis of discussions with hospital staff, later validated by a five-month review of inpatient treatment record coding and reporting, it was determined that Fort Jackson local customs and practice defined an ARD in terms of ICD-9 codes in the range 460 through 466 and 079.[a] A list of these codes extracted from ICD-9 is in Appendix C. As is indicated in the note under code 079, this category was not intended for primary diagnosis coding; however, medical records technicians frequently used a 079-series code when patient symptoms met generally accepted ARD characteristics but inpatient treatment record entries lacked sufficient specificity to code under 460-466.

A look at frequency of use of the various ICD-9 codes by Fort Jackson physicians for three fiscal years (1982, 1983, and 1984) confirmed the informal approximations of the medical record technicians——that most ARD cases were coded using two general diagnoses, 465 (acute upper respiratory infections of multiple or unspecified site) and 079 (viral infection in conditions classified elsewhere and of unspecified site), plus one more specific diagnosis, 462 (acute pharyngitis). The frequencies of code use are shown in Table 3 below. Each year over 92 percent of the ARD inpatients were coded using one of these three diagnoses; for the entire three-year period, 94.7 percent were coded thusly. Even with a turnover in the physician staff of the Fort Jackson MEDDAC during the three year period, frequency of use of the eight ICD-9

diagnostic codes from year to year was fairly consistent, with only minor changes in order.

TABLE 3

FREQUENCY OF USE OF ICD-9 CODES AS ARD PRIMARY DIAGNOSIS
FISCAL YEARS 1982-1984
(shown in descending order by total frequency of use)

ICD-9 Code	Number of ARD admissions				Percent of 3-yr total	Cumulative percent of 3-yr total
	FY82	FY83	FY84	Total FY82-84		
465	3,088	2,716	829	6,633	81.7	81.7
079	120	239	210	569	7.0	88.7
462	60	271	158	489	6.0	94.7
463	16	118	45	179	2.2	96.9
466	36	47	25	108	1.3	98.2
461	45	50	12	107	1.3	99.5
460	1	34	1	36	0.4	99.9
464	0	1	1	2	< 0.1	100.0
Total	3,366	3,476	1,281	8,123	100.0	100.0

SOURCE: U.S., Department of the Army, U.S. Army Patient Administration Systems and Biostatistics Activity, untitled reports generated from Individual Patient Data System database.

Historical Basic Training Workload and ARD Admissions Data

In order to gain perspective, in gross terms, of impacts of ARD admissions on the basic training population, ARD hospital admission data and basic trainee workload data for Fort Jackson from the three most recent fiscal years preceding this study were reviewed. A summary of the data is in Table 4 below.

TABLE 4

BASIC TRAINING WORKLOAD AND ARD ADMISSION DATA FOR FORT JACKSON FISCAL YEARS 1982-1984

Fiscal year	Trainees			ARD[b]			Incidence probability
	Inputs	Outputs	Approximate PAR[a]	ARD Admissions	Total bed-days	Mean bed-days	
1982	47,101	40,408	43,755	3,366	8,777	2.61	7.7%
1983	46,740	37,707	42,224	3,476	10,837	3.12	8.3%
1984	45,727	38,268	41,998	1,281	3,778	2.95	3.1%
Total	139,568	116,383	127,977	8,123	23,392	2.88	6.3%

[a]The mean of inputs and outputs/graduates was used as the best available approximation of the trainee population at risk of contracting ARD.

[b]To approximate as well as possible those ARD admissions attributable to basic trainees, the retrieval rule for these data was as follows: a primary discharge diagnosis of 460-466 or 079 AND a rank of E-1 through E-3 AND a length of active duty service less than three months.

SOURCE (for trainee data): U.S., Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, "Training Activity Course/Class Statistics (TACS) Report" generated from Army Training Requirements and Resources System (ATRRS) database.

SOURCE (for ARD data): U.S., Department of the Army, U.S. Army Patient Administration Systems and Biostatistics Activity (PASBA), untitled reports generated from Individual Patient Data System database.

Data showed that there was reasonable cause for continued concern by the Fort Jackson command group regarding impact of ARD related hospital admissions on initial entry training activities. In fiscal years 1982, 1983, and 1984, cumulative incidence rates of trainee ARD cases severe enough to cause a hospital admission

were 7.7 percent, 8.2 percent, and 3.1 percent, respectively. For these three fiscal years, at a minimum, 23,392 training man-days were lost because of hospital patient stays. Clearly, impact is much greater, but difficult to estimate. Many trainee patients, upon discharge from the hospital, returned to units with a light duty restriction, had to make up missed training, and, if enough critical training events were missed, were recycled into another class.

Note that probability of a basic trainee at Fort Jackson being hospitalized for ARD in 1984 was significantly lower than in 1983. While reasons for the decrease could not be identified with certainty, one must attribute at least some of that downward change to a year-round adenovirus vaccination program which began in late 1983.

Description of Barracks Design Styles

In a lengthy transition period during which the Army is building permanent structures at Fort Jackson to house trainees and is gradually phasing out temporary structures in use since World War II, initial entry trainees have necessarily been housed in barracks with three distinct design styles spanning over four decades. The barracks provide accommodations with a wide range of environmental conditions and internal living arrangements. A brief description of each barracks type follows in the paragraphs below.

The World War II barracks, built during the early 1940s at a cost of about $8,000, is a two-story wood frame structure built on a concrete foundation. Structure improvements include installation of exterior aluminum siding and replacement windows and doors, reinsulation concurrent with the removal of asbestos insulation materials, and minor interior renovations to floors, bathroom areas, and fixtures. The building is heated by its own individual fuel oil-fired heat plant and has no air conditioning capability for occupants. During warm seasons, natural ventilation via open windows is augmented by fans installed in the walls of sleeping bays. Originally designed to house 63 soldiers, the building under current minimum space standards now has a revised maximum capacity of 42 soldiers. Sleeping areas consist of two 20-soldier bays, one on each floor, and two small cadre rooms on the first floor. Bed and wall locker arrangement and a requirement for sleeping head-to-foot serve to minimize transmission of disease-causing microorganisms.[3]

The "rolling pin" barracks, built during the 1960s at a cost of about $500,000, is a three-story brick and masonry block structure on a reinforced conrete foundation. The building is centrally heated and air conditioned from a post central heating and cooling plant. Because of the controlled ventilation system, trainees are not allowed to open windows for natural ventilation. Improvements since original construction include installation of storm windows, reinsulation concurrent with removal of asbestos

insulation materials, upgrade of mechanical systems, and minor interior renovations. Under current minimum space standards, the building maximum capacity is 272 soldiers. Unlike open bay sleep areas in the other two types of barracks, sleep areas are eight-trainee squad rooms, with a half-wall and a center walk space in effect dividing the room into four cubicles. Two trainees with bed and wall locker share each cubicle. Head-to-foot sleeping arrangements are dictated.[4]

The "starship" barracks, the current Army standard for trainee billeting, built during the 1970s and 1980s at a cost of between $6 and $8 million, is a modern three-story structure with reinforced concrete foundation walls and floor slabs, masonry block partition walls, and brick exterior walls. Heat and air conditioning are provided from a post natural gas-fired central heating and cooling plant. Because of the controlled ventilation system, the trainees are not allowed to open windows for natural ventilation. The barracks complex can house a battalion of five 220-man companies, one in each of its company wings, for a total capacity of 1,100 trainees. Trainees sleep in 55-man open bays on the second and third floors. Bed and wall locker arrangement and a requirement for head-to-foot sleeping minimize transmission of disease-causing microorganisms.[5]

Commanders of units in each of the three barracks types comply with Army minimum space criterion of 72 square feet of net living area per trainee[6] when trainee load permits. During surge

periods of unusually large training companies when bays and squad rooms must house more than intended design capacity, each trainee receives less than his or her minimum standard space. These conditions are allowed by the Fort Jackson command for the duration of the surge training cycle, and increased emphasis is given to illness prevention measures. Surge periods normally occur in the summer months——June, July, and August. No basic training cycle included in this study was a surge, overstrength class.

Determination of Population at Risk and ARD Admissions from the Three Trainee Groups

Population at risk (PAR) summary calculations for the 46 basic training cycles in the study are shown in Appendix D. The total PAR included 7,824 trainees——2,501 female and 5,323 male. The 30 cycles of male trainees had a mean cycle strength of 177, while the 16 cycles of female trainees had a mean cycle strength of 156.

A figure in Appendix E displays in step-down diagrammatic presentation the determination of trainee ARD cases applicable to the cycles in the study. Of the 4,230 total patients admitted to Moncrief Army Community Hospital during the five months beginning January, 1985, 950 were basic trainees. Of these basic trainees, 559 were assigned to the 46 training cycles in the study sample, and 230 were codified by the hospital medical staff as having a primary diagnosis of ARD, as defined in this study. The trainee ARD cases comprised 151 males and 79 females.

<u>Analysis of Female Trainee Data</u>

Using observed numbers of ARD admissions of female basic trainees in the sample and computed PAR estimates of the three female trainee groups, a 2 x 3 chi-square contingency table was prepared and the expected values calculated using the formulas in Appendix F and a <u>Microstat</u> statistical application computer software program. Observed and expected occurrences and incidence probabilities of the three female groups are shown in Figure 2.

O = observed values
E = expected vaules

	Female Barracks Type W	R	S	
ARD Admission	O = 28 E = 26.2	O = 10 E = 13.9	O = 41 E = 38.9	79
No ARD Admission	O = 801 E = 802.8	O = 430 E = 426.1	O = 1191 E = 1193.1	2422
PAR =	829	440	1232	2501
IP =	.0338	.0227	.0333	

Fig 2. Chi-square Table for Female Trainee Data, All Barracks Types

A chi-square was computed using formulas in Appendix F and the <u>Microstat</u> program and was compared to the critical chi-square at the .95 percentile with 2 degrees of freedom (df):

Computed X^2 = 1.374

Critical $X^2_{.95}$ = 5.991 (df = 2)

p-value = .5030

On the basis of the test results, the null hypothesis of homogeneity could not be rejected at the .05 level of significance. The three female trainee groups appeared homogeneous with respect to ARD incidence. The conclusion was then drawn that there was no statistically significant difference between the incidence of ARD admissions of female trainees among three barracks environments. With the large p-value (p = .503) obtained in the test, however, the conclusion must be viewed accordingly. There is a 50 percent probability of obtaining the above results by mere chance alone.

Analysis of Male Trainee Data

Using observed numbers of ARD admissions of male basic trainees in the sample and computed PAR estimates of the three male groups, a 2 x 3 chi-square contingency table was prepared in the same manner as for the females. The results are in Figure 3.

O = observed values
E = expected vaules

	Male Barracks Type: W	R	S	
ARD Admission	O = 95 E = 69.8	O = 8 E = 26.4	O = 48 E = 54.8	151
No ARD Admission	O = 2367 E = 2392.2	O = 923 E = 904.6	O = 1882 E = 1875.3	5172
PAR =	2462	931	1930	5323
IP =	.0386	.0086	.0249	

Fig 3. Chi-square Table for Male Trainee Data, All Barracks Types

Similarly, a chi-square value was computed for males and compared to the critical chi-square, with the following results:

Computed X^2 = 23.392

Critical $X^2_{.95}$ = 5.991 (df = 2)

p-value $<$ .001

On the basis of the test results, the null hypothesis of homogeneity was rejected at a .05 level of significance. The three male trainee groups do not appear to be homogeneous with respect to the cumulative incidence of ARD admissions. Additional tests in the form of three 2 x 2 contingency tables were needed, in order to examine homogeneity, or lack thereof, among the pairs of male barracks groups.

In Figures 4, 5, and 6 are the contingency tables and the results of chi-square tests of the possible paired combinations of the three male barracks groups. For presentation simplicity, only observed values of ARD occurrence are shown. The chi-square computed values shown are without a continuity correction factor. Daniel, referencing the work of Grizzle and others, recommends against practical use of the Yates' continuity correction factor in 2 x 2 tables; it "too often leads to an overly conservative test, that is, use of the correction too often leads to nonrejection of the null hypothesis."[7] (Application of the continuity correction factor in the chi-square analyses in Figures 4 through 6 would not have changed the overall results in any one of the three tests.)

	Male Barracks Type W	Male Barracks Type R	
ARD Admission	95	8	103
No ARD Admission	2367	923	3290
PAR =	2462	931	3393
IP =	.0386	.0086	

Computed X^2 = 20.646
Critical $X^2_{.05}$ = 3.841
with df = 1
p-value < .001

Fig 4. Chi-square Table for Male Trainee Data, World War II versus Rolling Pin

	Male Barracks Type W	Male Barracks Type S	
ARD Admission	95	48	143
No ARD Admission	2367	1882	4249
PAR =	2462	1930	4392
IP =	.0386	.0249	

Computed X^2 = 6.462
Critical $X^2_{.05}$ = 3.841
with df = 1
p-value = .0140

Fig 5. Chi-square Table for Male Trainee Data, World War II versus Starship

	Male Barracks Type R	Male Barracks Type S	
ARD Admission	8	48	56
No ARD Admission	923	1882	2805
PAR =	931	1930	2861
IP =	.0086	.0249	

Computed X^2 = 8.671
Critical $X^2_{.05}$ = 3.841
with df = 1
p-value < .001

Fig 6. Chi-square Table for Male Trainee Data, Rolling Pin versus Starship

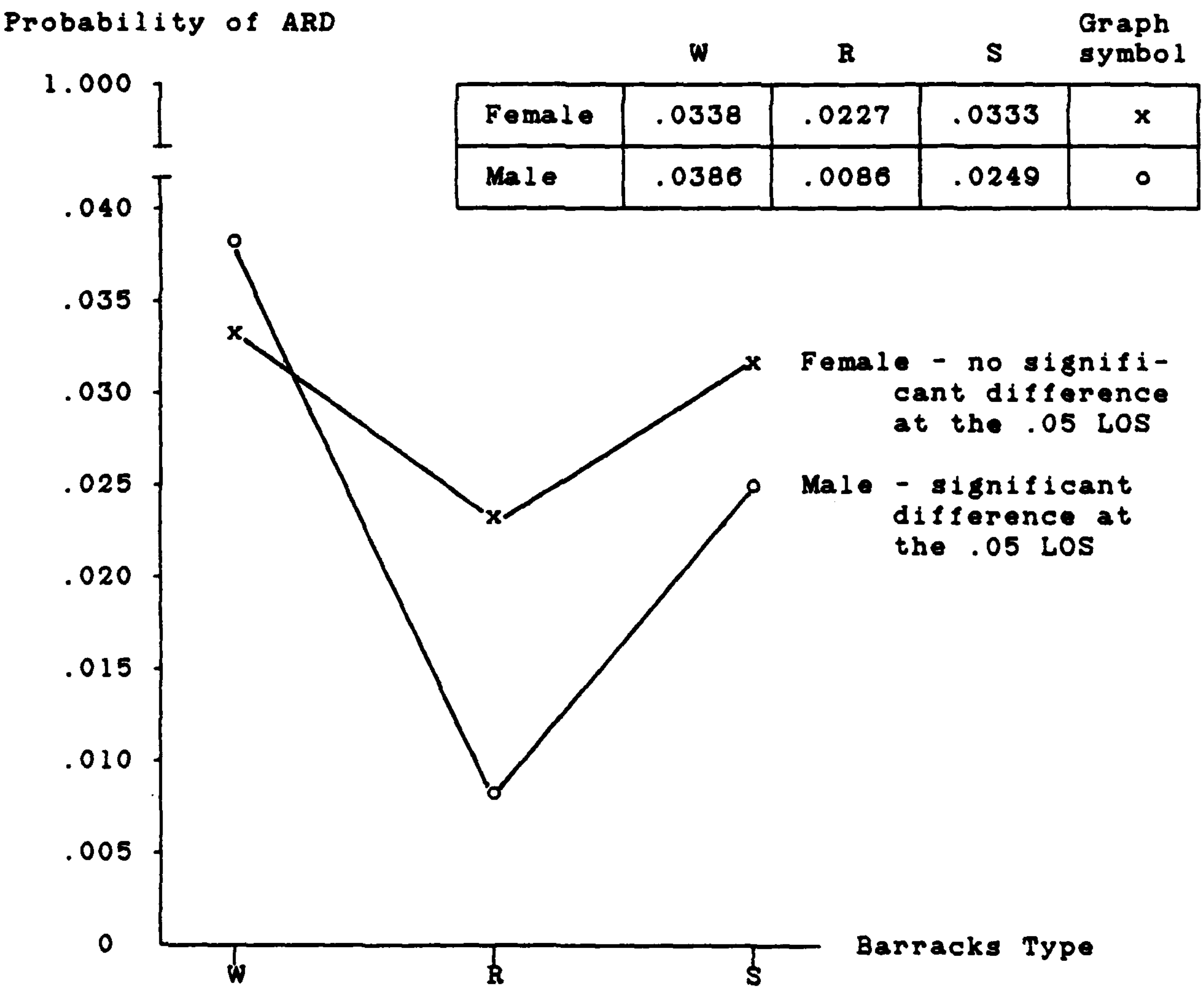
On the basis of the three 2 x 2 test results, the null hypothesis of homogeneity was rejected for each paired barracks combination. The conclusion was drawn that there was a statistically significant difference for the male trainees between the proportions of ARD hospital admissions as a function of barracks type. P-values obtained in each of the male tests indicate the relative rarity of obtaining the computed X^2 test statistic and give the reader some idea of reliability of the results. Probabilities were less than 1 in 1,000 of obtaining, by chance alone, the results in the "W versus R" and the "R versus S" comparisons and were 14 in 1,000 in the "W versus S" comparison.

Review of the Overall Results

Results of the tests of male and female trainee data by various barracks types may best be reviewed when displayed in a graphic summary form. Figure 7, providing such a summary, shows readily both direction and magnitude of the differences in ARD incidence probabilities for the six groups of trainees. As has been done throughout this study, the barracks types are arranged from left to right in design/construction chronological sequence to show improvement, or lack thereof, in ARD incidence with the modernization of facilities.

Overall, the probability of a female contracting ARD was higher than for a male. A higher female rate coincides with the earlier findings of Hoiberg[8] and Nathanson[9] and with rates for all Army initial entry training centers shown in Table 2. Also,

with the demonstrated efficacy of adenovirus vaccine abundant in published literature, the policy of not mass immunizing female recruits upon reception station arrival should logically result in higher female ARD admission rates. The male/female rate relationship held true in the two modern barracks facility types; in the World War II barracks, however, females had a slightly lower



	W	R	S	Graph symbol
Female	.0338	.0227	.0333	x
Male	.0386	.0086	.0249	o

Figure 7. Graphic Display of Overall Test Results

probability than did males (.0048 difference). This unexpected reversal, though minimal, could not be explained from available data by engineer or medical personnel. Several interrelated factors might have been at work, contributing to a reversal of the expected lower male, higher female rate relationship. There was a difference in relative sizes of the male and female populations at risk. Data in Appendix D show that mean female PAR in World War II barracks cycles, was about 6 percent less than mean male PAR (166 for females, 176 for males). The range of female cycle strengths, 112 to 203, was much wider than of males, 145 to 211. In general, the females in older barracks were less crowded than males. Another possible factor was that, for males crowded into older barracks, a lack of climate control capabilities may have created conditions conducive to ARD causing pathogens other than adenoviruses against which male trainees were immunized. Without cultural/serological testing, the mix of respiratory pathogens in ARD patients from World War II barracks was unknown, making the aforementioned factor merely speculative.

Incidence rates for both males and females in the rolling pin barracks were the lowest of any of the three barracks types. The one obvious difference in rolling pin design is internal segregation of trainees into 8-man rooms in lieu of the open-bay configuration of the other two types. While magnitude of difference in probability is less for females than for males, direction of variability is the same for both genders. Interestingly, data

in Appendix D shows that mean PAR for males in rolling pins is the highest of the three barracks types, while the mean PAR for females is the lowest of the three barracks types. Rolling pin rates in this study tend to support a supposition that billeting trainees in smaller groups lowers incidence of ARD. The study of Navy and Marine Corps recruits by Arlander and the experience of the British armed forces lend credence to this supposition.[10] Fort Jackson engineering and housing staff were quite surprised by lowest rates in the rolling pin structures, for they had been operating under the presumption that the newer starship barracks provided a healthier environment. In fact, programs for fiscal years 1988 and 1989 funded upgrades in the rolling pin heat, air conditioning, and ventilation (HVAC) systems and a more frequent replacement of filter elements.[11]

ARD incidence rates for groups in the starship barracks ——now Army standard barracks design for basic trainees——ranked second lowest behind the rolling pins for both males and females. True to expected relationship, males had a lower incidence than their female counterparts in these barracks, presumably because of protection partly afforded by adenovirus immunizations. To their benefit, starship females had a lesser average strength per cycle than did starship males (154 compared to 175). In immunized male trainees, the starship rate was significantly lower than the World War II barracks rate. With both barracks using an open bay concept, one primary environment difference related to their

ventilation systems; however, technical evaluation and comparison of the ventilation systems were outside the scope of study.

Footnotes

[1]U.S., Department of the Army, Office of The Surgeon General, "Letter: Acute Respiratory Disease Surveillance and Adenovirus Vaccination Programs," Washington, D. C., December 9, 1981, p. 2.

[2]Interviews with James H. Nelson, M.D., Colonel, U.S. Army, Chief, Preventive Medicine Service, U.S. Army Medical Department Activity, Fort Jackson, S.C., on numerous dates during the period October, 1984, through May, 1985; interviews with Herbert E. Segal, M.D., Colonel, U.S. Army, Commander, U.S. Army Medical Department Activity, Fort Jackson, S.C. on numerous dates during the period October, 1984, through May, 1985.

[3]Interviews with Franklin D. Cooper, Jr., Chief, Master Planning Branch, Directorate of Engineering and Housing, Fort Jackson, S. C., on numerous dates during November, 1984, through March, 1985, and August 3, 1989; discussions with basic training cadre during tours of the barracks November, 1984, through March, 1985; reviews of the Directorate of Engineering and Housing real property records.

[4]Ibid.

[5]Ibid.

[6]U.S., Department of the Army, Office of the Chief of Engineers, Billeting Operations, Army Regulation 210-11 (Washington, D. C.: Government Printing Office, July 15, 1983): 3-3.

[7]Wayne W. Daniel, Biostatistics: A Foundation for Analysis in the Health Sciences, 3rd ed. (New York: John Wiley & Sons, 1983), p. 373.

[8]Anne Hoiberg, "Health Care Needs of Women in the Navy," Military Medicine 144 (February 1979): 103, 104, 106, 109.

[9]Constance A. Nathanson, "Illness and the Feminine Role: A Theoretical Review," Social Science and Medicine 9 (February 1975): 57.

[10]T. R. Arlander et al., "Epidemiology and Prevention of Acute Respiratory Diseases in Naval Recruits. IV. An Epidemiologic Study of Respiratory Illness Patterns in Navy and Marine Corps Recruits," American Journal of Public Health 55 (January 1965): 75-78.

[11]Interview with Franklin D. Cooper, Jr., Chief, Master Planning Branch, Directorate of Engineering and Housing, Fort Jackson, S. C., on August 3, 1989.

III. CONCLUSION

Summary

From a population of Army basic trainees at Fort Jackson, South Carolina, a sample of new soldiers entering the eight-week basic training course during the first three calendar months of 1985 was selected and followed through the training period. Data collected on the sample included gender, the type of barracks in which housed, the weekly assigned strengths of and attrition from training classes, and hospital admissions with primary diagnosis. Sampled trainees were separated into six groups based upon a male or female gender and one of the three styles of barracks——World War II, rolling pin, or starship——in which they lived. Cumulative incidence of hospital admissions for a primary diagnosis of acute respiratory disease (ARD) in each of three male and three female groups was calculated. With chi-square tests of homogeneity, ARD incidence rates within the male groups and within the female groups were compared in order to answer the research question——does a difference exist among cumulative incidence of ARD hospital admissions of groups of basic trainees as defined by the design of the barracks structure in which they are housed?

Incidence rates for males and females were analyzed separately rather than as gender-combined groups by barracks type due to two controlled factors in effect at Fort Jackson. First, the males receive an oral bivalent adenovirus vaccine, affording them partial protection against these ARD-causing agents; females are

not immunized against the adenoviruses. Second, the proportions of female trainees assigned to training battalions, and therefore to specific barracks types, are controlled within set limits.

Results of testing for the female trainees indicated that there was no significant difference in the incidence of ARD among the three barracks groups. The probability of a female trainee in any one type of barracks contracting ARD was fairly consistent with that of a female in either of the other two barracks types. The high p-value obtained in the female testing somewhat limited the usefulness of the conclusion of "no difference."

Results of testing for male trainees indicated statistically significant differences in the incidence of ARD among each of the three barracks groups when compared to any other barracks group. A male trainee in a rolling pin barracks had a much lower probability of being admitted to the hospital as an ARD patient than his counterparts in the other two barracks types. A male trainee in a World War II barracks had the highest of the group probabilities of becoming an ARD inpatient. A starship trainee's probability fell between those of the other two groups.

When viewing the ARD incidence probabilities by barracks type, a consistent pattern emerged and held true for both males and females. Barracks group ARD incidence rates, rank ordered from highest to lowest for both genders, were first World War II, then starship, and finally rolling pin. One would certainly hope to see a continued downward ARD trend corresponding with decreas-

ing age of barracks buildings, indicating progressive improvement in illness-retarding environment. Such was not the case with the rolling pins and starships.

Implications for Management

Scope of this research effort was purposefully limited. Factors other than barracks environment which may have affected host response to ARD causing agents were not considered. Evans suggested other factors——allergies, genetic predisposition to ARD, prior exposure to pathogens, physiologic and psychological state, and smoking habits, to name a few.[1] Many of these factors would have been difficult to include in the study. In addition, technical evaluations of the internal conditions within barracks structures——e.g., measurement of air flow rates, air exchanges, and humidity——were not a part of the research design. Thus, one must consider the limited scope when viewing stated implications and recommendations. In spite of scope limitations, results did allow at least some speculation about barracks impacts on troop health.

With imminent removal of World War II barracks buildings from full-time use as billets for basic trainees at Fort Jackson, it is neither prudent nor cost effective to study further how the older barracks environments affect rates of illness. Higher ARD incidence rates in the study sample for these long-used barracks support their retirement from service.

For the remaining two types of barracks structures, which will be used for many years to come, continued investigation is warranted. This study is hopefully the first of several at Fort Jackson to examine impacts of trainee billeting accommodations on patterns of illness, and in particular ARD. The Army's adoption of the starship barracks design as a standard for billeting basic trainees and the resulting construction of numerous starship complexes at Fort Jackson and other initial entry training centers firmly entrenches open bays as a temporary living environment of thousands of future trainees. Though starship design may provide optimum configuration for operation and control of basic training units, this study has cast doubt upon the local presumption that newer is better, that starships provide also optimum environment for reduction of illness rates. Obviously, one three-month study of limited scope provides an insufficient weight of evidence to warrant a recommendation that planners alter master construction guidelines to return from open bay to small group billet designs; it is merely a step in that direction. Much more study is needed to justify change in design standards.

Recommendations

Recommendation 1: Further comprehensive study

The research question of barracks environments and their impacts upon incidence of ARD in basic trainees is wide open for further study and validation. Followup research of illness rates in the Fort Jackson rolling pin and starship barracks should be

conducted. Study design should be sufficiently comprehensive not only to discover statistically significant differences, if any, but also to provide evidence supporting reasons for differences. Future research should consider data on technical environmental and clinical factors. Specifically, evaluation and comparison of HVAC systems of the two barracks types, to include measurement of air flows, air exchanges, and humidity levels through the study period, should be accomplished. Additionally, cultural and serological laboratory testing of all sample ARD patients should be conducted to provide information on potential interrelationships between barracks environments, immunizations, and disease-causing microorganisms. Consideration should also be given to including outpatient ARD morbidity, when the medical treatment facility's clinical data maintenance program includes such capability.

Recommendation 2: Routine evaluation of barracks environments by preventive medicine personnel

In the absence of personnel and time resources to devote to the comprehensive study recommended above, at a minimum, HVAC systems of both the rolling pin and starship barracks should be evaluated periodically by qualified staff of Fort Jackson MEDDAC Preventive Medicine Service. Technical evaluation and comparison of ventilation system performance should be made using mechanical measurement of air flows, air exchanges, and humidity levels, and visual observations of air movement with smoke producing devices. Particular attention should be given all areas of the sleeping bays in starship barracks.

Footnote

[1]Alfred S. Evans, "Clinical Syndromes in Adults Caused by Respiratory Infections," _Medical Clinics of North America_ 51 (May 1967): 805-06.

APPENDIX A

LIST OF BASIC TRAINING BRIGADES AND BATTALIONS AND THE TYPE OF BARRACKS OCCUPIED

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LIST OF BASIC TRAINING BRIGADES AND BATTALIONS AND THE TYPE OF BARRACKS OCCUPIED

TABLE 5

BASIC TRAINING UNITS AND BARRACKS OCCUPIED

Unit	Type of Barracks Structure Occupied
1st BASIC TRAINING BRIGADE:	
1st Battalion	World War II
2d Battalion	'Rolling Pin'
3d Battalion	'Rolling Pin'
4th Battalion	World War II
5th Battalion	World War II
10th Battalion	World War II
2d BASIC TRAINING BRIGADE:	
6th Battalion	'Starship'
7th Battalion	'Starship'
8th Battalion	'Starship'
9th Battalion	'Starship'

Note: The terms 'rolling pin' and 'starship' developed among Army Corps of Engineers planning personnel. Each barracks design type was given a nickname to coincide with its aerial 'footprint' or impression on a map. A map 'footprint' of the 'rolling pin' barracks structure, with wide troop living areas in the center of the building and narrower cadre room areas on each end, resembles a rolling pin. Likewise, a 'footprint' of a 'starship' barracks structure resembles the shape of some futuristic starship in a video game.

SOURCE: Personal observations during tours of the facilities on Fort Jackson and discussions with staff of the training brigades and the Directorate of Engineering, November, 1984.

APPENDIX B

EXAMPLE OF A WEEKLY STATUS REPORT OF BASIC TRAINING UNITS

APPENDIX B

EXAMPLE OF A WEEKLY STATUS REPORT OF BASIC TRAINING UNITS

STATUS OF BASIC TRAINING (BT & AIT UNITS)

TO: CG, USATC&FJ FROM: DPT (SFC Webster, 7585) AS OF: 7 Jan 65

BN	CO	START	PRESENT	WK	START	GRAD/SHIP	REP	RA	TOTAL		REMARKS	
	A	177 (M)	157 (M)	7	3 Nov	15/15 Jan	17	140	MALE	656	51	58
	E	229 (M)	187 (M)	7	6 Nov	15/15 Jan	13	174	FEMALE	161	50	58
8th	D	176 (M)	182 (M)	7	8 Nov	18/19 Jan	35	147	TOTAL	817	49	57
	B	158 (F)	161 (F)	7	9 Nov	18/19 Jan	73	88			48	56
	C	141 (M)	130 (M)	7	10 Nov	18/19 Jan	49	81			49	58
	D	153 (M)	155 (M)	7	12 Nov	21/22 Jan	23	132	MALE	350	48	56
2d	A	213 (M)	195 (M)	6	15 Nov	24/25 Jan	23	172	FEMALE	319	48	56
	C	179 (F)	162 (F)	6	16 Nov	25/26 Jan	38	124	TOTAL	669	48	56
	B	163 (F)	157 (F)	6	19 Nov	25/26 Jan	68	89			46	53
	E	203 (M)	193 (M)	6	17 Nov	26/28 Jan	47	146	MALE	565	48	57
9th	D	196 (M)	181 (M)	6	19 Nov	29/30 Jan	60	121	FEMALE	150	50	57
	A	135 (F)	150 (F)	5	21 Nov	31/1 Feb	28	122	TOTAL	715	49	57
	B	203 (M)	191 (M)	5	21 Nov	1/2 Feb	26	165			50	57
	C	209 (M)	209 (M)	5	24 Nov	1/2 Feb	84	125	MALE	637	47	55
3d	A	132 (F)	145 (F)	5	24 Nov	4/5 Feb	52	93	FEMALE	145	49	58
	D	199 (M)	205 (M)	4	28 Nov	6/7 Feb	47	158	TOTAL	782	48	56
	B	220 (M)	223 (M)	4	29 Nov	7/8 Feb	39	184			48	56
	A	168 (F)	168 (F)	4	30 Nov	8/9 Feb	50	118	MALE	627	48	56
	D	193 (M)	201 (M)	4	30 Nov	9/10 Feb	69	132	FEMALE	314	49	57
1st	C	205 (M)	207 (M)	4	3 Dec	11/12 Feb	46	161	TOTAL	941	48	55
	E	151 (F)	146 (F)	3	5 Dec	15/16 Feb	30	116			49	57
	B	206 (M)	219 (M)	3	6 Dec	15/16 Feb	67	152			49	57
	E	198 (M)	209 (M)	3	7 Dec	16/17 Feb	80	129	MALE	424	49	57
10th	D	209 (M)	215 (M)	3	10 Dec	19/20 Feb	58	157	FEMALE	201	49	55
	C	194 (F)	201 (F)	3	10 Dec	21/22 Feb	29	172	TOTAL	625	51	57
	D	199 (M)	196 (M)	2	12 Dec	22/23 Feb	24	172	MALE	750	48	57
	C	158 (M)	173 (M)	2	13 Dec	22/24 Feb	18	155	FEMALE	115	48	57
7th	E	172 (M)	172 (M)	2	14 Dec	27/28 Feb	59	113	TOTAL	865	48	57
	A	96 (F)	115 (F)	2	15 Dec	27/1 Mar	22	93			48	57
	B	209 (M)	209 (M)	1	4 Jan	1/2 Mar	59	150			50	58
	E	205 (F)	205 (F)	1	5 Jan	4/5 Mar	39	166	MALE	198	50	60
	A	198 (M)	198 (M)	0	8 Jan	5/6 Mar	49	149	FEMALE	205	50	58
4th	C	220 (M)	PF	F					TOTAL	403		
	B	220 (F)	PF	F								
	D			M			1421	4396				
	A			M					MALE	0		
6th	C			M					FEMALE	0		
	D			M					TOTAL	0		
	B			M								
	E			M								
	C			M					MALE	0		
	E			M					FEMALE	0		
5th	A			M					TOTAL	0		
	B			M								
	D			M					TNG/ACT			

TOTAL START (M) 4,266 (F) 1,581 = 5,847 PRESENT (M) 4,207 (F) 1,610 = 5,817
PROJECTED FILL (M) 220 (F) 220 PROJECTED TOTAL FILL 440
TOTAL COMPANIES IN MAINTENANCE 14

	11th	252 (males)	469 (females)	TOTAL	721
4th	12th	609 (males)	21 (females)	TOTAL	630
Bde	14th	205 (males)	316 (females)	TOTAL	521
	15th	712 (males)	201 (females)	TOTAL	913
BDE TOTAL		1778 (males)	1007 (females)	TOTAL	2785

		FIRST FILL DATE
4th	3d	1 female company
	4th	
	5th	
	1st	2 female companies
	2d	
6th	3d	
	4th	
	5th	
	1st	2 female companies
	2d	
5th	3d	
	4th	
	5th	

Fig. 8. Example Weekly Basic Training Status Report

APPENDIX C

LIST OF DISEASES OF THE UPPER RESPIRATORY SYSTEM USED TO DEFINE A PATIENT ADMISSION AS "ACUTE RESPIRATORY DISEASE"

APPENDIX C

LIST OF DISEASES OF THE UPPER RESPIRATORY SYSTEM USED TO DEFINE A PATIENT ADMISSION AS 'ACUTE RESPIRATORY DISEASE'

TABLE 6

ARD DIAGNOSIS CODES FROM ICD-9

ACUTE RESPIRATORY INFECTIONS (460-466)

Excludes: pneumonia and influenza (480-487)

---

460 Acute nasopharyngitis (common cold)

Coryza (acute)
Nasal catarrh, acute
Nasopharyngiyis:
  NOS
  acute
  infective NOS

Rhinitis:
  acute
  infective

Excludes: nasopharyngitis, chronic (472.2)
  pharyngitis:
    acute or unspecified (462)
    chronic (472.1)
  rhinitis:
    allergic (477.-)
    chronic or unspecofoed (472.0)
  sore throat:
    acute or unspecified (462)
    chronic (472.1)

---

461 Acute sinusitis

Includes: abscess, empyema, infection, inflammation, suppuration — acute, of sinus (accessory) (nasal)

Excludes: chronic or unspecified (473.-)

461.0 Maxillary
Acute antritis

461.1 Frontal

461.2 Ethmoidal

461.3 Sphenoidal

461.8 Other
Acute pansinusitis

461.9 Unspecified
Acute sinusitis NOS

---

462 Acute pharyngitis

Acute sore throat NOS
Pharyngitis (acute):
  NOS
  gangrenous
  infective
  phlegmonous
  pneumococcal
Pharyngitis (acute):
  staphylococcal
  suppurative
  ulcerative
Sore throat (viral) NOS
Viral pharyngitis
Excludes: abscess:
    peritonsillar (quinsy) (475)
    pharyngeal (478.2)
    retropharyngeal (478.2)
  chronic pharyngitis (472.1)
  the conditions if specified as (due to):
    Coxsackie virus (074.0)
    herpes simplex (054.7)
    influenzal (487.1)
    septic (034.0)
    streptococcal (034.0)

---

463 Acute tonsillitis

Tonsillitis (acute):
  NOS
  follicular
  gangrenous
  infective
  pneumococcal
Tonsillitis (acute):
  septic
  staphylococcal
  suppurative
  ulcerative
  viral
Excludes: peritonsillar abscess (quinsy) (475)
  sore throat:
    acute or NOS (462)
    septic (034.0)
  streptococcal tonsillitis (034.0)

---

464 Acute laryngitis and tracheitis

Excludes: when specified as due to streptococcus (034.0)

464.0 Acute laryngitis

Laryngitis (acute):
- NOS
- Haemophilus influenzae (H. influenzae)
- oedematous
- pneumococcal
- septic
- suppurative
- ulcerative

Excludes: chronic laryngitis (476.-)
influenzal laryngitis (487.1)

464.1 Acute tracheitis

Tracheitis (acute):
- NOS
- catarrhal
- viral

Excludes: chronic tracheitis (491.8)

464.2 Acute laryngotracheitis

Laryngotracheitis (acute)
Tracheitis (acute) with laryngitis (acute)

464.3 Acute epiglottitis

464.4 Croup

---

465 Acute upper respiratory infections of multiple or unspecified site

465.0 Acute laryngopharyngitis

465.8 Other multiple sites

465.9 Uspecified site

Upper respiratory:
- disease (acute)
- infection (acute)

Excludes: Upper respiratory infection due to:
- influenza (487.1)
- streptococcus (034.0)

---

466 Acute bronchitis and bronchiolitis

Includes: the listed conditions with or without mention of obstruction or bronchospasm
Excludes: for single-condition coding, acute exacerbation of chronic bronchitis (491.-)

466.0 Acute bronchitis

Bronchitis, acute or subacute:
- fibrinous
- membranous
- pneumococcal
- purulent
- septic

Bronchitis, acute or subacute:
- viral
- with tracheitis

Croupous bronchitis

Tracheobronchitis, acute

466.1 Acute bronchiolitis

Bronchiolitis (acute)

Capillary pneumonia

OTHER DISEASES DUE TO VIRUSES AND CHLAMYDIAE (070-079)

070-078 (omitted, not used in this study)

---

079 Viral infection in conditions classified elsewhere and of unspecified site

Note: This category will rarely be used for primary coding. It is provided as an additional code where it is desired to identify the viral agent in diseases classified elsewhere. This category will also be used in primary coding to classify virus infection of unspecified nature or site.

079.0 Adenovirus

079.1 ECHO virus

079.2 Coxsackie virus

079.3 Rhinovirus

079.8 Other

079.9 Unspecified

Viral infection NOS

Excludes: viraemia NOS (790.8)

SOURCE: World Health Organization, Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death. vol. 1 (Geneva: World Health Organization, 1977), pp. 72-75, 283-285. (Commonly referred to as the International Classification of Diseases, Ninth Revision, or ICD-9.)

APPENDIX D

SUMMARY OF POPULATION AT RISK CALCULATIONS

APPENDIX D

SUMMARY OF POPULATION AT RISK CALCULATIONS

TABLE 7

POPULATION AT RISK CALCULATIONS

Cycle	Unit	Bar-rack	Sex	Males W	Males R	Males S	Females W	Females R	Females S
1	B-7-2	S	M			210.6			
2	E-4-1	W	F				202.5		
3	A-4-1	W	M	197.5					
4	C-4-1	W	M	202.0					
5	B-4-1	W	F				199.3		
6	(See NOTE below)								
7	B-10-1	W	M	182.8					
8	D-4-1	W	M	210.8					
9	A-6-2	S	M			173.5			
10	E-6-2	S	F						172.6
11	B-6-2	S	M			183.3			
12	D-6-2	S	M			211.0			
13	C-6-2	S	F						154.5
14	D-2-1	R	M		173.9				
15	A-2-1	R	M		191.5				
16	C-2-1	R	F					137.6	
17	B-2-1	R	M		184.3				
18	C-8-2	S	F						155.0
19	B-8-2	S	M			171.4			
20	D-8-2	S	F						166.9
21	E-8-2	S	M			162.1			
22	A-8-2	S	M			172.0			
23	C-5-1	W	M	144.8					
24	A-5-1	W	F				112.1		
25	B-5-1	W	M	191.5					
26	E-5-1	W	M	169.0					
27	D-5-1	W	M	149.2					
28	A-9-2	S	F						116.6
29	B-9-2	S	M			138.2			
30	C-9-2	S	F						138.7
31	D-9-2	S	M			152.5			
32	E-9-2	S	M			147.1			
33	B-3-1	R	F					152.6	
34	A-3-1	R	M		193.9				
35	C-3-1	R	M		186.9				
36	D-3-1	R	F					149.6	
37	C-1-1	W	M	202.7					
38	A-1-1	W	M	151.3					

Cycle	Unit	Bar-rack	Sex	Males W	Males R	Males S	Females W	Females R	Females S
39	E-1-1	W	F				147.1		
40	D-1-1	W	M	157.2					
41	B-1-1	W	M	147.5					
42	C-10-1	W	F				167.8		
43	E-10-1	W	M	180.9					
44	D-10-1	W	M	174.9					
45	C-7-2	S	F						170.9
46	B-7-2	S	M			208.5			
47	E-7-2	S	F						156.3
Male PAR by barracks				2462.1	930.5	1930.2			
(rounded to)				2462	931	1930			
Total male PAR					5323				
Female PAR by barracks							828.8	439.8	1231.5
(rounded to)							829	440	1232
Total female PAR								2501	
Number of cycles				14	5	11	5	3	8
					30			16	
Cycle mean strength				176	186	175	166	147	154
					177			156	

Note: Cycle 6 was not included in its appropriate sample (males in World War II barracks) because this basic training class was a special nine-week cycle during which trainers were testing proposed changes in an expanded BT program of instruction.

Legend for abbreviations and data annotations
Unit x-x-x: Company-Battalion-Brigade
Barracks type: W World War II; R Rolling Pin; S Starship
Sex: M Male; F Female

APPENDIX E

RECAPITULATION OF THE DETERMINATION OF ARD ADMISSIONS FROM THE BASIC TRAINEE SAMPLE

APPENDIX E

RECAPITULATION OF THE DETERMINATION OF ARD ADMISSIONS FROM THE BASIC TRAINEE SAMPLE

- 4,230 persons registered into Moncrief Army Community Hospital during period January 1 through May 31, 1985 (register numbers 579,955 through 584,184)
  - 2,817 register numbers applicable to persons other than basic trainees
  - 1,413 register numbers applicable to basic trainees
    - 463 basic trainee carded for record only (CRO) cases
    - 950 basic trainee inpatient admissions
      - 391 basic trainee inpatients not assigned to the sample training cycles
      - 559 basic trainee inpatients assigned to the 46-cycle sample (cycles 1-5 and 7-47)
        - 329 basic trainee inpatients with a primary diagnosis other than ARD
        - 230 basic trainee inpatients with a primary diagnosis of ARD
          - 151 male trainee ARD cases
          - 79 female trainee ARD cases

Fig. 9. Determination of Trainee ARD Cases

APPENDIX F

CALCULATION FORMULAS USED IN DATA ANALYSES

APPENDIX F

CALCULATION FORMULAS USED IN DATA ANALYSES

TABLE 8

STATISTICAL FORMULAS

Calculated chi-square (X^2)

$$X^2 = \sum_{i=1}^{k} [(O_i - E_i)^2/E_i]$$ or stated in a much simpler form,

$$X^2 = \sum \left[\frac{O^2}{E}\right] - N$$

where O = observed value
E = expected value
N = total number in the PAR

Expected value of each cell

$$E = \frac{RT \times CT}{GT}$$

where RT = row total
CT = column total
GT = grand total

Degrees of freedom

$$df = (R-1)(C-1)$$

where R = number of rows in table
C = number of columns in table

Critical values from a percentages of chi-square distribution table

For the 2 x 3 contingency tables:

Critical $X^2_{.95} = 5.991$ (at .95 percentile with df = 2)

For the 2 x 2 contingency tables:

Critical $X^2_{.95} = 3.841$ (at .95 percentile with df = 1)

SOURCE: Wayne W. Daniel. Biostatistics: A Foundation For Analysis in the Health Sciences. 3rd ed. (New York: John Wiley & Sons, 1983), pp. 357-358, 376-378, 381, 495.

APPENDIX G

GLOSSARY OF TERMS

APPENDIX G

GLOSSARY OF TERMS

Admission is placing a person under treatment or observation in a hospital. Day of admission is the day the hospital makes a formal acceptance by assigning a register number and initiating an ITR [inpatient treatment record]. Admission is when a patient is provided room, board, and continuous nursing service in an area of the hospital where patients normally stay at least overnight. (AR 40-400, p. GLOSSARY 1)

Bed day is a day in which a patient occupies an authorized operating hospital bed at census-taking hour, normally midnight, or when a patient is admitted to and discharged from the hospital on the same day. (AR 40-400, p. GLOSSARY 2)

Carded for record only (CRO) is a term used to describe a special case in which, for purposes of personnel accountability in a military medical environment, a person is not admitted to an inpatient status but is still assigned a register number and has an inpatient treatment record (ITR). Examples of cases where CRO records are initiated include the deaths of certain categories of personnel who were not inpatients at the recording hospital, and the separation or retirement of military personnel for medical conditions. (AR 40-400, p. GLOSSARY 2, and AR 40-66, p. 10)

Course is a formal program of instruction for Army personnel which is identified by a course number and which consists of one or more classes. (ATRRS Users Manual, p. A-1)

Class is a numbered iteration of a course for a given number of students/trainees. For basic trainees, class is often referred to as cycle. (ATRRS Users Manual, p. A-1)

Cumulative incidence (also called incidence probability) is the proportion of new cases of a disease that develops in a population at risk (PAR) of getting the disease over a stated period of time. Alternately stated, it is the probability or the chance of an individual in the PAR developing the disease during a specified period of time. (Abraham M. Lilienfeld and David E. Lilienfeld, Foundations of Epidemiology, pp. 138-139.)

Fill and train policy is a term used to describe the manner in which trainees arriving daily at initial entry training installations are continually formed into training companies and then actively entered into the training system. The system results in multiple cycle starts each week. (TRADOC Reg 350-6, p. 15)

Fiscal year for all Army activities is a twelve-month period beginning October 1st each year.

Initial entry training (IET) is the period of new soldiers' introduction to the Army, during which they learn basic military skills and discipline and specific job skills. IET includes both basic training (BT) and advanced individual training (AIT). Also included is one station unit training (OSUT), which is a combined BT and AIT program. (TRADOC Reg 350-6, p. 3)

Inpatient treatment record (ITR) is the medical record used by Army hospitals having authorized beds for inpatient care. An ITR is initiated upon admission to the hospital and completed at the end of hospitalization. (AR 40-400, p. GLOSSARY 4)

P-value for a hypothesis test is the probability of obtaining, when the null hypothesis H_o is true, a value of the test statistic as extreme as or more extreme than the one actually computed. The p-value is also defined as the samllest value of α for which the null hypothesis H_o can be rejected. (Wayne W. Daniel, Biostatistics: A Foundation for Analysis in the Health Sciences, p. 168)

Register number is an identifying number assigned to each patient at time of admission to an Army hospital and to carded for record (CRO) cases. The register number is a sequentially assigned whole number, beginning with 1 for the first patient admitted to a facility and continuing consecutively for the life of the Army hospital facility. (AR 40-66, p. 30)

Training attrition denotes the loss of students or trainees who enrolled in military institutional training courses and who did not graduate. Training attrition rates are a function of the actual input versus graduate data. (ATRRS Users Manual, p. A-1)

SOURCES: Indicated parenthetically after definition.

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